

Space Weather Technical Forecast

Issued on Monday 30 September 2024 at 01:14 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Chance of M-flares (R1-R2 Blackouts).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity is Moderate with an M1.7 observed at 29/1424UTC from AR3842 in the southeast quadrant.

There are currently eight sunspot regions on the visible disc. The most notable remains the aforementioned AR3842, which has shown some development, with further complexity becoming apparent as it rotates into a better viewing angle. This region contains a weak delta spot on the southern periphery of its main leader spot and was responsible for the largest flare of the period. AR3834 and AR3835 have continued to slowly mature, with any growth having now stalled. AR3836 continues to be a broad area of mainly negative polarity spots, with one very small positive spot in its northern portion, resulting in a non-standard but inactive and mature configuration. AR3840 in the northwest and AR3848 in the southeast were both numbered, with the latter rapidly developing over the period. All other remaining regions appear to be small and simple, or showing signs of decay.

A CME was observed off the southwest limb in association with a long-duration C5 flare from near AR3834, which has been analysed. Results in Enlil show the CME missing ahead of Earth's orbit.

Solar Wind / Geomagnetic Activity:

Solar winds started the period at background levels, near 300km/s, before increasing to slightly elevated levels, peaking near 500km/s at 29/2137 UTC, due to connection with CH76/- and the arrival of its fast solar wind. Density was initially below average, but increased to above average, with peak of 34 ppcc at 29/1241 UTC, before declining to below average values. Interplanetary Magnetic Field, Bt, was initially weak, increasing to moderate, and briefly strong interval, with a peak of 15nT at 29/1450 UTC, ahead of coronal hole fast wind. The north-south component was mostly negative (southward) early in the period, before re-orientating to become predominately positive (northward) from 29/1200 UTC, with brief negative intervals. Phi angle was predominately positive (away from the Sun) early in the period, before switching to mostly negative (towards the Sun) from 29/1320 UTC as connection to CH76/- was established.

Geomagnetic activity was mostly Quiet to Unsettled, with an Active interval observed between 29/1200-1500 UTC due to coronal hole fast wind influences.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 was at background levels. High energy electron flux (greater than 2MeV) observed by GOES16 was at background to moderate levels (at diurnal peak), with a peak value of 574 pfu at 29/1430 UTC. The associated 24-hour fluence was below the Active threshold. The 30/0000 UTC observation was 8.12e6 integrated pfu.

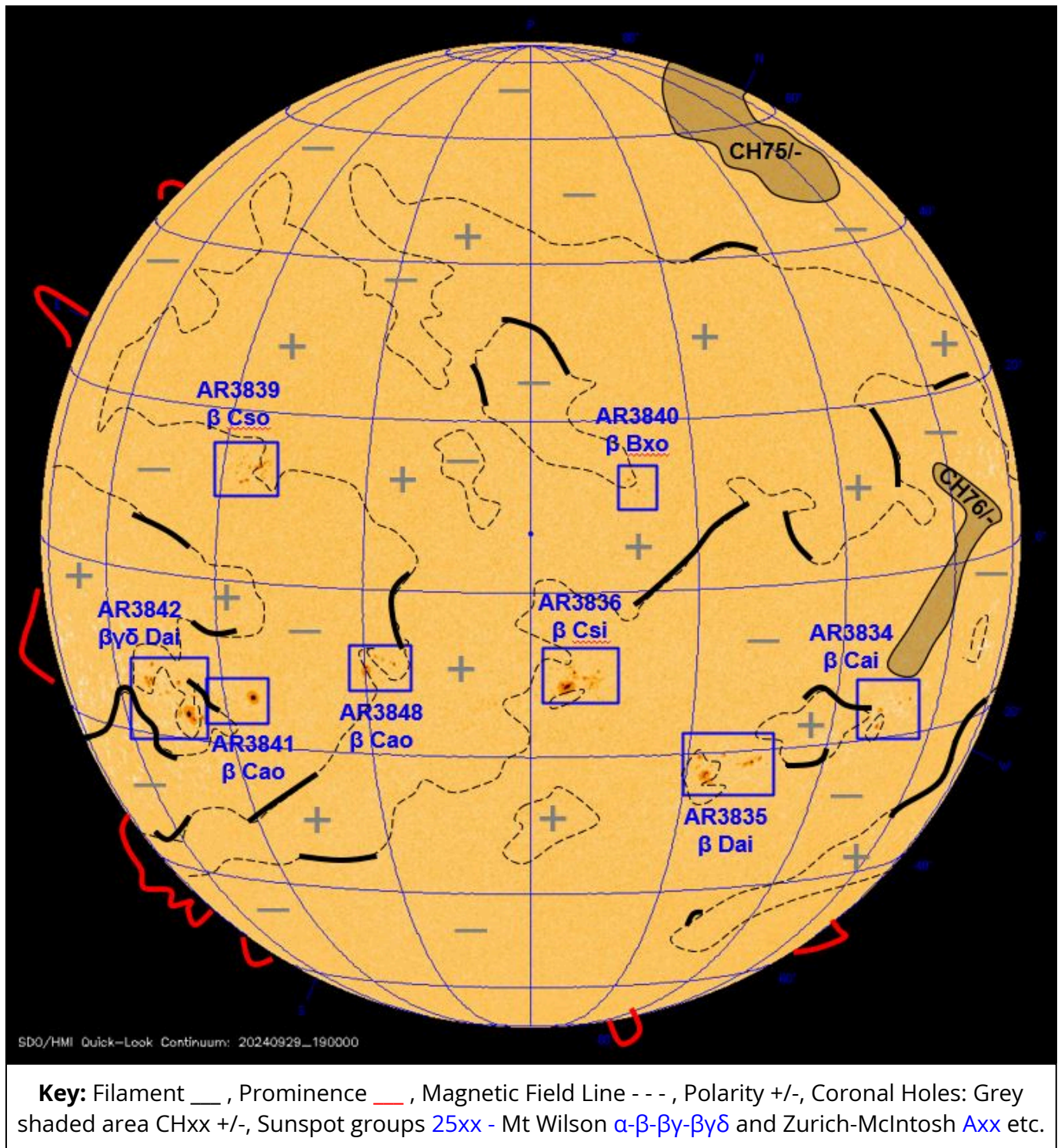
Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected, with a chance of further isolated M-class flares. There is a very slight chance of an isolated X-class flare, mostly likely from AR3842.

Solar Wind / Geomagnetic Activity: There are no Earth directed CMEs in the forecast. Solar winds are likely to remain slightly elevated on Day 1 (30 Sep) due to coronal hole fast wind influences, before returning to background levels on Day 2 (01 Oct). Mainly Quiet (Kp 0-2) geomagnetic conditions are expected, but with a chance of Unsettled to Active (Kp 3-4) intervals possible from CH fast wind influences on Day 1 (30 Sep).

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 is forecast to persist at background. High energy electron flux at GOES16 have reduced from Moderate to background levels, after the arrival of a fast wind from CH76/-. There is the slight chance of a possible recovery to Moderate levels later in the period. The associated 24 hour fluence is expected to remain below the Active threshold (1e8 total pfu).

Figure 1: Solar Synoptic Map valid 29/1900 UTC



Geomagnetic Storms

There are no Earth-directed CMEs in the forecast. A CME was observed coming off the southwest limb in association with a long-period C5 flare, which has been analysed. The results from ENLIL suggest the bulk of the CME will miss ahead of Earth's orbit.

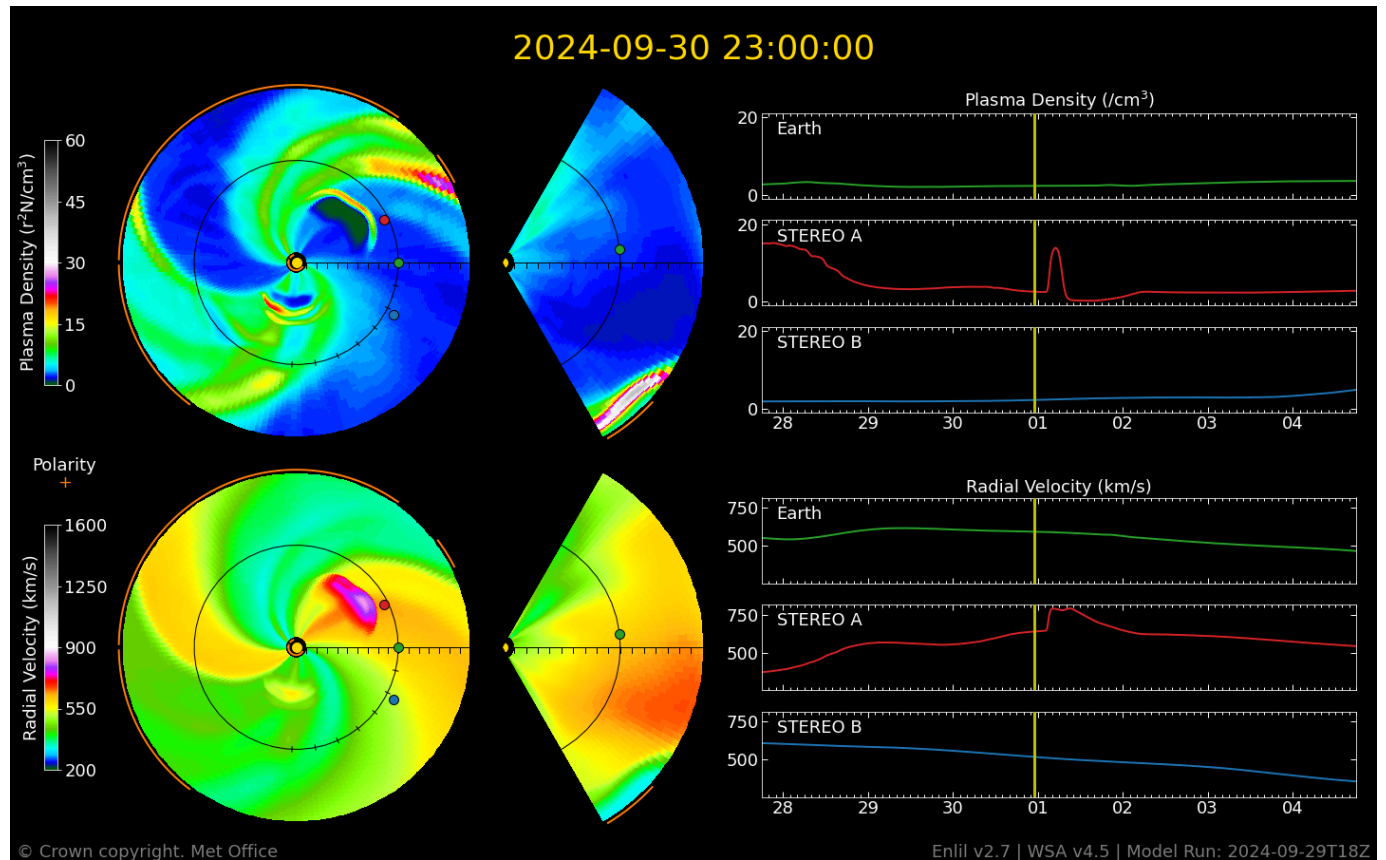
A second CME was observed from over the northeast limb, although this is deemed to be far-sided. There are a number of filaments currently on the Earth-facing disc, which brings a slightly increased chance of CMEs being produced over the coming days.

Solar winds are currently at slightly elevated levels, between 450-500km/s due to the arrival of a fast wind from CH76/-. However, this is unlikely to be impactful due to this feature being an unfavourable polarity (negative) for a strong connection at this time of year, and also due its narrow appearance. MOSWOC Enlil is also providing little useful guidance due to it instead modelling a swathe of fast winds that has not been observed and has no clear source.

Mainly Quiet (Kp 0-2) geomagnetic conditions are expected, but with a chance of Unsettled to Active (Kp 3-4) intervals possible from CH fast wind influences on Day 1 (30 Sep). Confidence becomes lower by Day 4 (03 Oct) due to the number of filaments currently on the disc, as any disruption could result in an Earth-directed CME, and a subsequent increase in geomagnetic activity is possible later in the period.

Geomagnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	1	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC Enlil model. Note that Enlil currently has Earth in a broad and fast high speed stream, which isn't the case in reality.



Radio Blackouts - X-Ray Flares

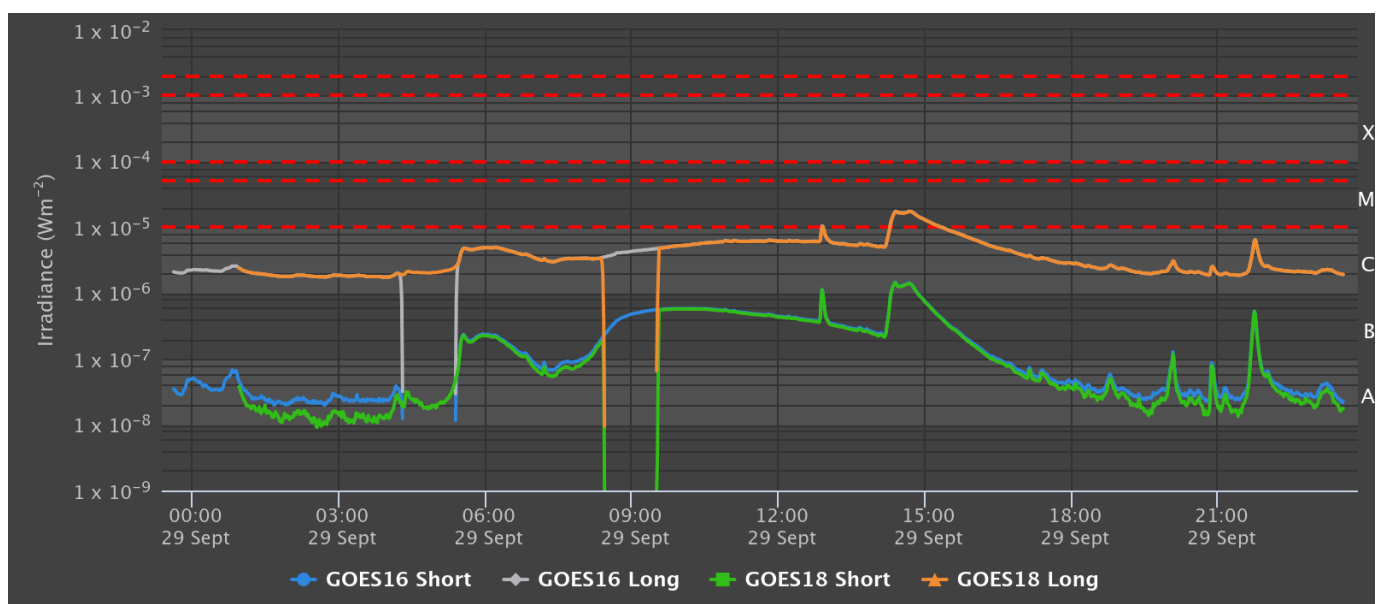
Low to Moderate activity is forecast with an ongoing chance of isolated M-class flares. There is a slight chance of X-class flares

There are currently eight sunspot regions on the visible disc. The most notable is AR3842 in the southeast, which is now moving into a less oblique viewing angle. This is a relatively small and ragged looking region, but set amongst a broad area of plage with a small delta spot on the the southern edge of its negative leader, and also appears bright on SDO aia-94 imagery. Further details are also likely to become apparent as it moves into a better viewing angle, along with some ongoing growth possible. This region is the most likely source of any larger or more significant flares.

The other regions are generally simpler, but include a few of note. AR3836 in the south-centre is an unusual region, consisting of a number of spots, but nearly all of a single negative polarity besides two small positive spots, one on its northern periphery and the other trailing in the east. AR3835 and AR3834, both on the southwest disc, remain relatively simple bipolar regions and are showing signs of maturing with some of their smaller spots coalescing into larger ones.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability		(Yes/No)	(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	50	50	50	50
Very Active	R3-R5 (X Class)	No	10	10	10	10

Figure 3: GOES-16 and 18 X-ray flux trace.

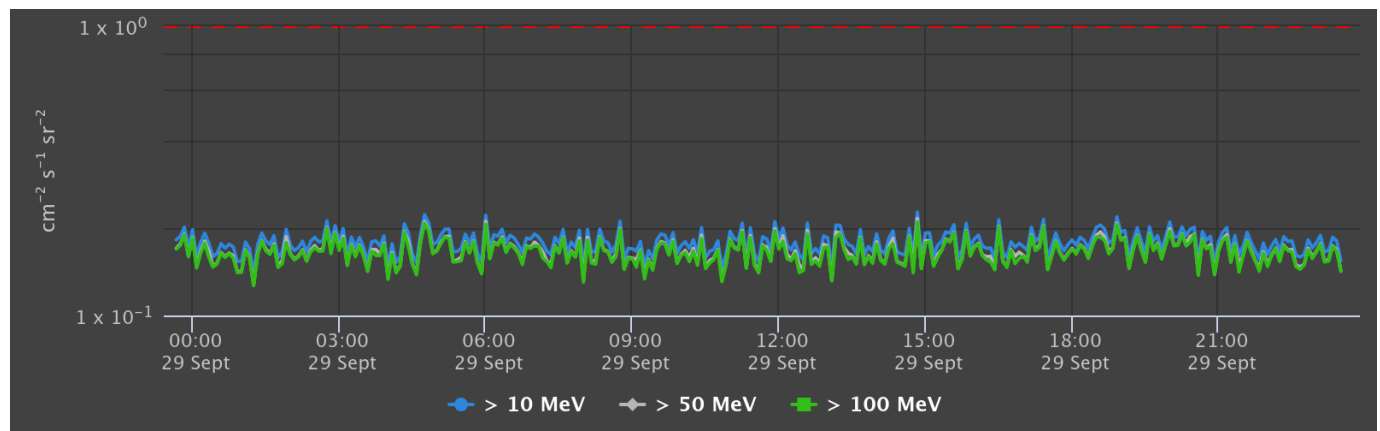


Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES18 is forecast to persist at background levels. The current visible sunspots are generally small and simple providing only modest contributions to flare risk, and are unlikely to significantly impact proton flux at Earth. However, given the number of notable filaments currently on the disc, there is also a very low, albeit non-zero chance of observable protons should any significant filament eruption occur during the period.

Radiation Storms	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq S1$	No	5	5	5	5
Very Active	$\geq S3$ *	No	1	1	1	1
* $S3 \geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and/or $50 \text{ MeV} \geq 10 \text{ pfu}$. ($\text{pfu} = \text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)						

Figure 4: GOES-18 Proton Flux



High Energy Electrons ($\geq 2\text{MeV}$)

High energy electron flux (greater than 2MeV) observed by GOES16 was at background to Moderate levels (at diurnal peak). Electrons are expected to remain at background levels after the recent arrival of a fast wind from CH76/-, which should keep them suppressed in the short-term. A possible recovery to Moderate levels (at diurnal peak) is likely towards the end of the period.

The associated 24 hour fluence is forecast to stay below Active ($1\text{e}8$ total pfu), in agreement with MOSWOC REFM, although a slight increasing trend is likely towards the end of the period, but is still expected to remain below the Active threshold.

GEO Electron Environment	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2\text{ MeV}$ $\geq 1\times10^8$	No	1	1	1	1
Very Active	$\geq 2\text{ MeV}$ $\geq 1\times10^9$	No	1	1	1	1

Figure 5: GOES-16 Electron Flux

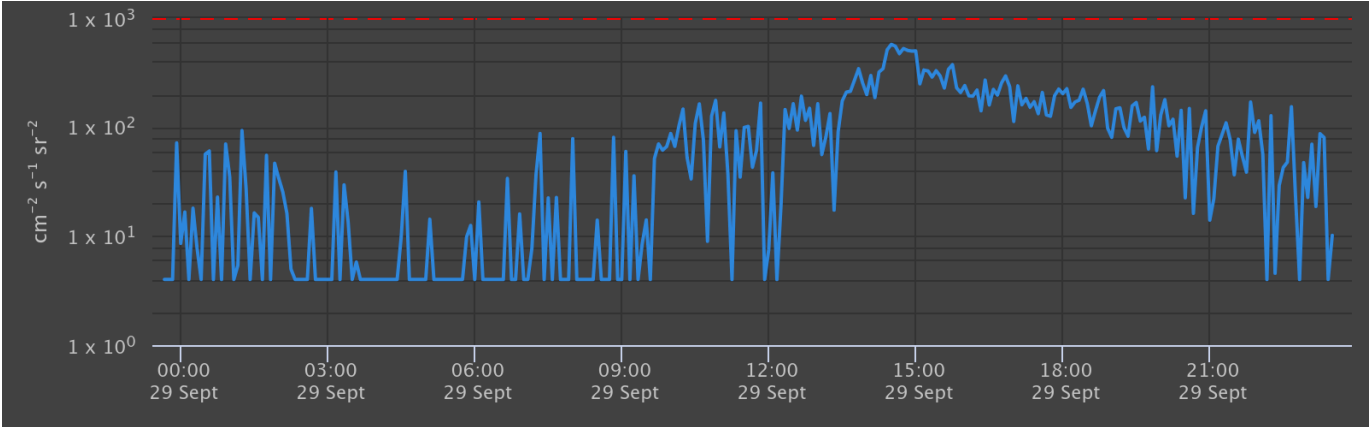


Figure 6: MOSWOC REFM Electron Fluence.

